

Rev. V1

Features

High Gain: 26.0 dBP1dB: 33.5 dBmP3dB: 34.0 dBm

IM3 Level: -36 dBc @ POUT = +20 dBm/tone
 Power Added Efficiency: 28% @ P3dB
 Temperature Compensated Output Power

Detector

Lead-Free 5 mm AQFN 32-lead Package

RoHS* Compliant

Applications

Point-to-Point

VSAT

Description

The MAAP-011316 is a 2 W, 4-stage power amplifier assembled in a lead-free 5 mm 32-lead air cavity QFN plastic package. This power amplifier operates from 27.5 to 31 GHz and provides 26 dB of linear gain, 2 W saturated output power and 28% efficiency while biased at 6 V.

The MAAP-011316 can be used as a power amplifier stage or as a driver stage in higher power applications. This device is ideally suited for VSAT and 28 GHz PTP applications.

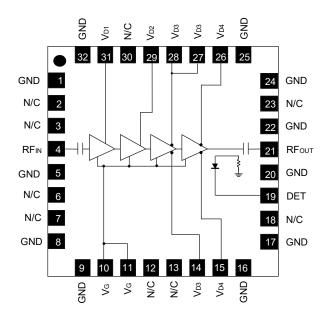
This product is fabricated using a GaAs pHEMT process which features full passivation for enhanced reliability.

Ordering Information^{1,2}

Part Number	Package	
MAAP-011316	Bulk part	
MAAP-011316-TR0500	500 part reel	
MAAP-011316-001SMB	Sample Board	

- 1. Reference Application Note M513 for reel size information.
- 2. All sample boards include 3 loose parts.

Functional Schematic



Pin Configuration^{3,4}

Pin#	Pin Name	Description	
1, 5, 8, 9, 16, 17, 20, 22, 24, 25, 32	GND	Ground	
2, 3 , 6, 7, 12, 13, 18, 23, 30	N/C	No Connection	
4	RF _{IN}	RF Input	
10, 11	V _G	Gate Voltage	
14, 27, 28	V_{D3}	Drain Voltage 3	
15, 26	V_{D4}	Drain Voltage 4	
19	DET	Power Detector	
21	RF _{OUT}	RF Output	
29	V_{D2}	Drain Voltage 2	
31	V _{D1}	Drain Voltage 1	

- MACOM recommends connecting all No Connection (N/C) pins to ground.
- The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

^{*} Restrictions on Hazardous Substances, compliant to current RoHS EU directive.



Rev. V1

Electrical Specifications: $T_A = +25$ °C, $V_D = 6$ V, $Z_0 = 50$ Ω

Parameter	Test Conditions	Units	Min.	Тур.	Max.
Gain	27.5 GHz 31.0 GHz	dB	23 17	26 21	_
Output Power (@ Pin = +12dBm)	27.5 GHz 31.0 GHz	dBm	32 31	33.5 33.5	_
IM3 Level	P _{OUT} = 20 dBm / tone	dBc	_	-36	_
Power Added Efficiency	P _{IN} = 12 dBm	%	_	28	_
Input Return Loss	_	dB	_	10	_
Output Return Loss	_	dB	_	15	_
Quiescent Current	I _{DSQ} (see bias conditions, page 4)	mA	_	900	_
Drain Current ($V_{D1} + V_{D2} + V_{D3} + V_{D4}$)	P _{IN} = 12 dBm	mA	_	1500	_

Maximum Operating Conditions

Parameter	Rating		
Input Power	P _{IN} ≤3 dB Compression		
Junction Temperature ^{5,6}	+160°C		
Operating Temperature	-40°C to +85°C		

- Operating at nominal conditions with junction temperature ≤ +160°C will ensure MTTF > 1 x 10⁶ hours.
- 6. Junction Temperature (T_J) = T_C + Θ_{JC} * ((V * I) (P_{OUT} P_{IN})) Typical thermal resistance (Θ_{JC}) = 6.6 °C/W.

 a) For T_C = +25°C

 T_J = +78°C @ 6 V, 1.5 A, P_{OUT} = 34.0 dBm, P_{IN} = 12 dBm b) For T_C = +85°C

 $T_J = 138$ °C @ 6 V, 1.5 A, $P_{OUT} = 34.0$ dBm, $P_{IN} = 12$ dBm

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A devices.

Absolute Maximum Ratings^{7,8}

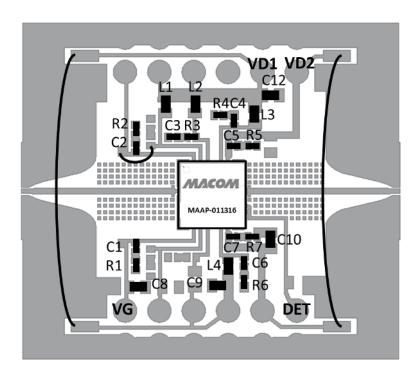
Parameter	Absolute Maximum	
Input Power	15 dBm	
Drain Voltage	+6.5 V	
Gate Voltage	-3 to 0 V	
Junction Temperature ⁹	+175°C	
Storage Temperature	-65°C to +125°C	

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- MACOM does not recommend sustained operation near these survivability limits.
- Junction temperature directly affects device MTTF. Junction temperature should be kept as low as possible to maximize lifetime

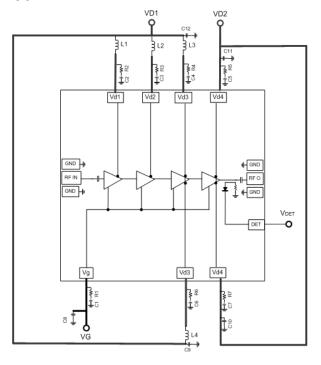


Rev. V1

Sample Board Layout



Application Schematic



Parts List

Part	Value	Case Style
C1 - C7	0.01 μF	0402
C8 - C12	22 µF	0603
R1 - R7	10 Ω	0402
L1 - L4	Ferrite bead Murata BLM18HE601SN1D	0603

Sample Board Material Specifications

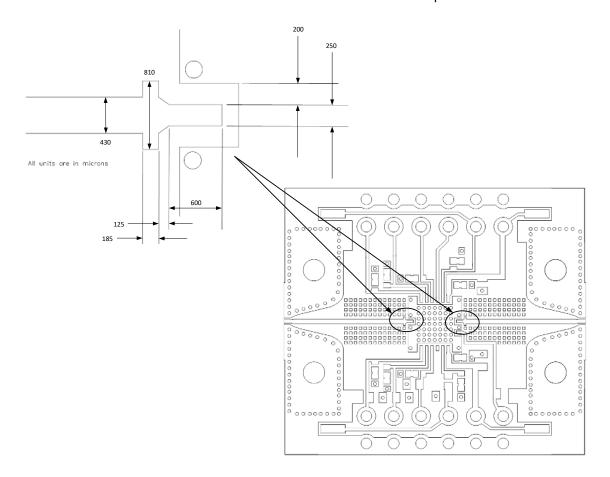
Top Layer: 1/2 oz Copper Cladding, 0.017 mm thickness Dielectric Layer: Rogers RO4003C 0.203 mm thickness Bottom Layer: 1/2 oz Copper Cladding, 0.017 mm thickness Finished overall thickness: 0.238 mm



Rev. V1

Recommended PCB Layout Detail:

RF input and output pre-matching circuit patterns are identical and are designed to compensate packaging effects. Transmission line dimensions apply to a PCB with 0.203 mm thick Rogers RO4003C laminate dielectric. Performance curves shown in this data sheet were measured with these circuit patterns.



Biasing Conditions

Recommended biasing conditions are V_D = 6 V, I_{DSQ} = 900 mA (controlled with V_G). The drain bias voltage range is 5.5 to 6.5 V.

 V_G pins 10 and 11 are connected internally; choose either pin for layout convenience. Muting can be accomplished by setting the V_G to the pinched off voltage ($V_G = -2 \text{ V}$).

 V_D bias must be applied to V_D1 , V_D2 , V_D3 , and V_D4 pins. V_D3 pins 27 and 28 are connected internally: choose pin 14, 27 or 28 for layout convenience. Two V_D4 pins 15 and 26 (not connected internally) are required for current symmetry.

Operating the MAAP-011316

Turn-on

- 1. Apply V_G (-1.5 V).
- 2. Apply V_D (6.0 V typical).
- 3. Set I_{DQ} by adjusting V_G more positive (typically -0.9 to -1.0 V for I_{DSQ} = 900 mA).
- 4. Apply RF_{IN} signal.

Turn-off

- 1. Remove RFIN signal.
- 2. Decrease V_G to -1.5 V.
- 3. Decrease V_D to 0 V.

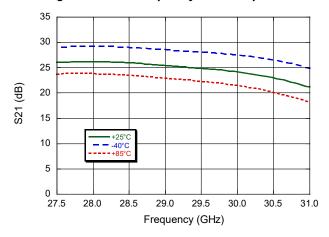
Δ



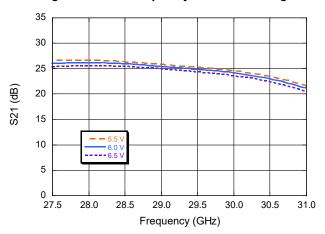
Rev. V1

Typical Performance Curves: $V_D = 6 \text{ V}$, $I_{DSQ} = 900 \text{ mA}$, $V_G = -0.9 \text{ V}$ typical

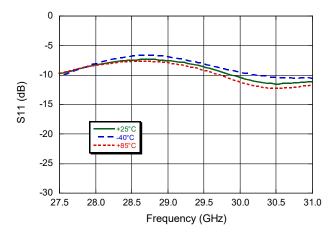
Small Signal Gain vs. Frequency over Temperature



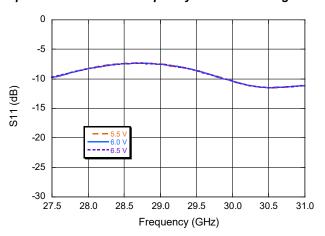
Small Signal Gain vs. Frequency over Bias Voltage



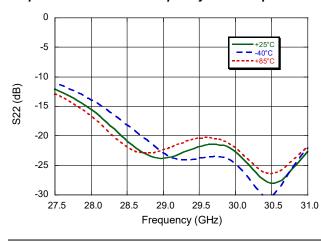
Input Return Loss vs. Frequency over Temperature



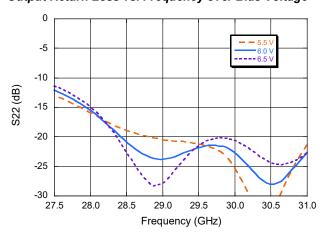
Input Return Loss vs. Frequency over Bias Voltage



Output Return Loss vs. Frequency over Temperature



Output Return Loss vs. Frequency over Bias Voltage

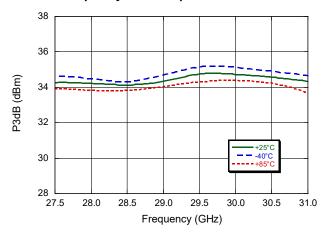




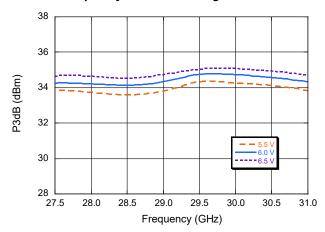
Rev. V1

Typical Performance Curves: $V_D = 6 \text{ V}$, $I_{DSQ} = 900 \text{ mA}$, $V_G = -0.9 \text{ V}$ typical

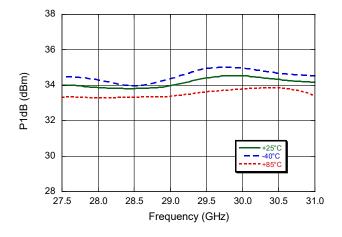
P3dB vs. Frequency over Temperature



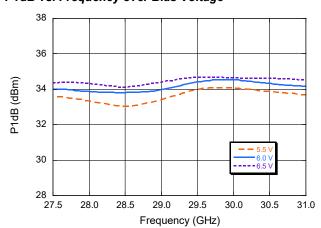
P3dB vs. Frequency over Bias Voltage



P1dB vs. Frequency over Temperature



P1dB vs. Frequency over Bias Voltage

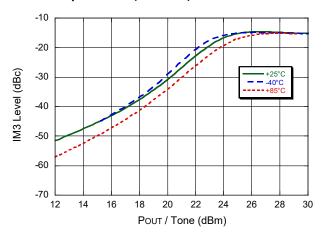




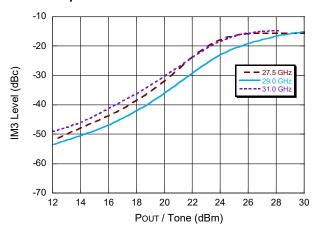
Rev. V1

Typical Performance Curves: $V_D = 6 \text{ V}$, $I_{DSQ} = 900 \text{ mA}$, $V_G = -0.9 \text{ V}$ typical

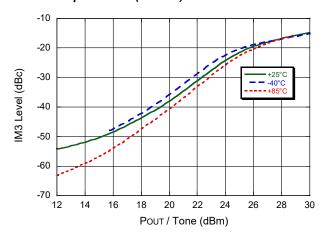
IM3 vs. Output Power (27.5 GHz)



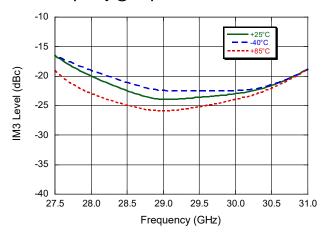
IM3 vs. Output Power



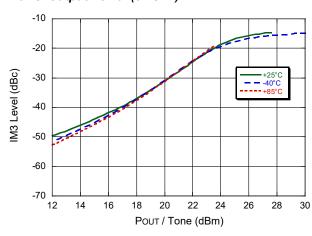
IM3 vs. Output Power (29 GHz)



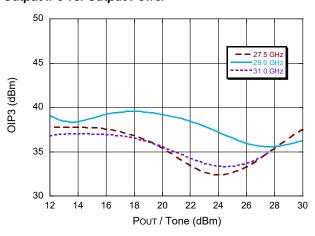
IM3 vs. Frequency @ Output Power = 24 dBm/tone



IM3 vs. Output Power (31 GHz)



Output IP3 vs. Output Power



MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

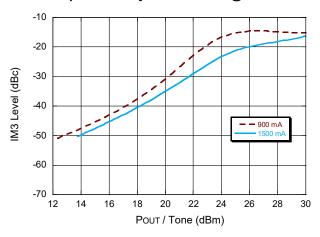
Visit www.macom.com for additional data sheets and product information.



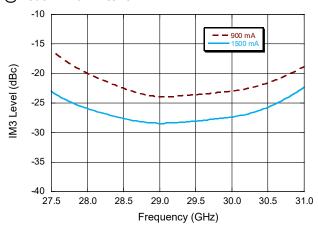
Rev. V1

Typical Performance Curves: V_D = 6 V, 25°C

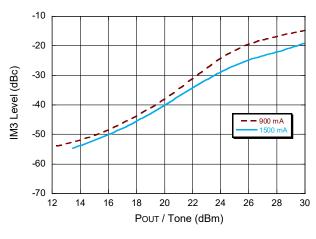
IM3 vs. Output Power by Drain Current @ 27.5 GHz



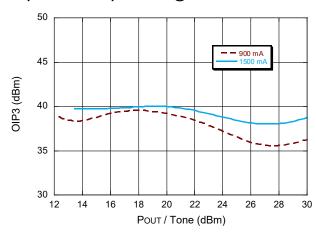
IM3 vs. Frequency by Drain Current @ Pout = 24 dBm/tone



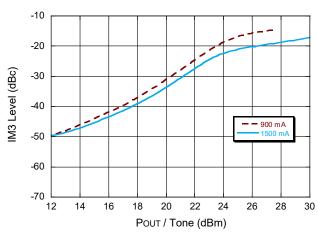
IM3 vs. Output Power by Drain Current @ 29 GHz



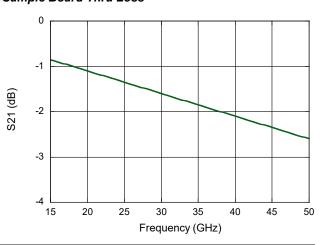
Output IP3 vs. Output Power @ 29 GHz



IM3 vs. Output Power by Drain Current @ 31 GHz



Sample Board Thru Loss



8

MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

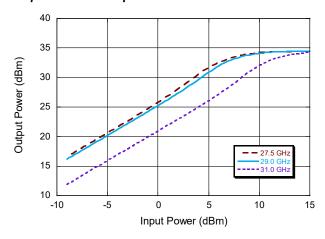
Visit www.macom.com for additional data sheets and product information.



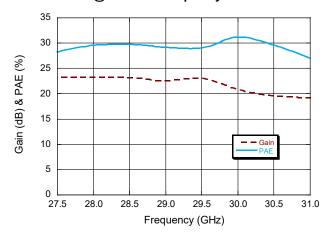
Rev. V1

Typical Performance Curves: $V_D = 6 \text{ V}$, $I_{DSQ} = 900 \text{ mA}$, $V_G = -0.9 \text{ V}$ typical, +25°C

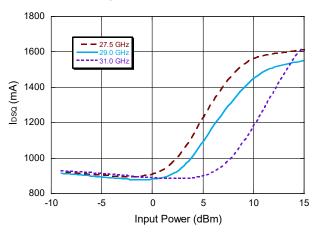
Output Power vs. Input Power



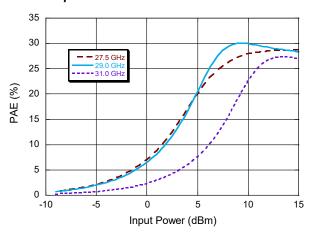
Gain and PAE @ P3dB vs. Frequency



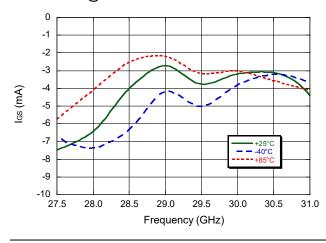
Bias Current vs. Input Power



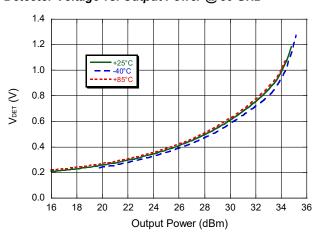
PAE vs. Input Power



Gate Current @ P3dB



Detector Voltage vs. Output Power @ 30 GHz



9

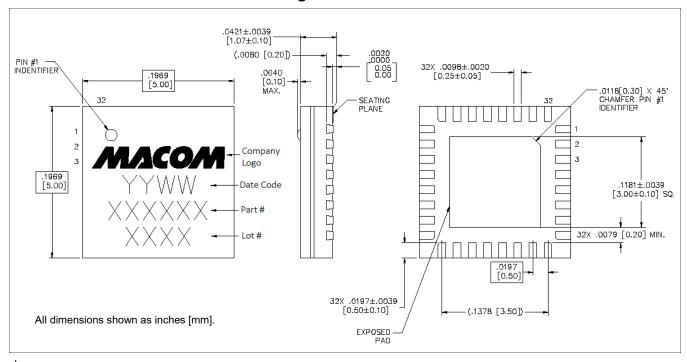
MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Visit www.macom.com for additional data sheets and product information.



Rev. V1

Lead-Free 5 mm 32-Lead AQFN Package[†]



Reference Application Note S2083 for lead-free solder reflow recommendations. Meets JEDEC moisture sensitivity level 3 requirements. Plating is NiPdAu.

Power Amplifier, 2 W 27.5 - 31.0 GHz



MAAP-011316

Rev. V1

MACOM Technology Solutions Inc. ("MACOM"). All rights reserved.

These materials are provided in connection with MACOM's products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.